A first-surface solar prism and a dark glass shade were employed; the diameter of the object-glass is 4 inches.

The Observatory, Jamaica,
1878, *May* 7.

Observations of the Transit of Mercury, May 6, 1878, *at Princeton, N. Jersey. Lat.* $40^\circ\ 20'\ 58''\cdot 0 \pm 0''\cdot 2$, *Long.* $9^m\ 36^s \pm 1^s$ *E. of Washington.* By Professor C. A. Young.

The instrument used was the new Clark Equatoreal, of $9\frac{1}{2}$ inches aperture, armed with a Merz polarising solar eye-piece. The whole aperture was employed. The magnifying power at the first observation was 155; all the rest were made with a power of 223.

Flying clouds were troublesome, and the seeing was very bad, from the unsteadiness of the air, but the phenomena took place with a rapidity and decisiveness quite in contrast with what I had seen at the transit of *Venus*, so that I think the probable error of the times given cannot much, if at all, exceed one second.

The timepiece used was a sidereal clock beating once in two seconds. Its errors were carefully determined by star observations on the nights preceding and following the transit, and it was compared with the solar clock by means of the chronograph.

The solar clock was also compared with Washington time by means of the telegraphic noon signals which are sent daily to New York. By the kindness of Mr. Merrihew, the Superintendent of the Eastern Division of the Western Union Telegraph Company, these signals were transmitted over the wire which passes into the Princeton office for several days preceding the transit and on the day of the transit. The time was carried from the Telegraph Office to the Observatory by means of a pocket chronometer. The telegraphic comparisons were not, however, quite satisfactory, owing to interruptions from unskilled operators on the line, who broke it continually; but the approximate longitude stated above, and derived from these comparisons, agrees well with that deduced from the coast survey maps.

The first contact (external) at Ingress was noted at

$1^h\ 11^m\ 35^s\cdot 7$ Sid. = $22^h\ 14^m\ 13^s\cdot 9$ Pr. M.T. Magnifying power 155.

The second contact (internal) at

$1^h\ 14^m\ 27^s\cdot 7$ Sid. = $22^h\ 17^m\ 05^s\cdot 4$ Pr. M.T. Magnifying power 223.

At $1^h\ 12^m\ 41^s\cdot 7$ Sid. or $22^h\ 15^m\ 29^s\cdot 7$ M.T. was noted the

Ingress of the estimated centre of the planet, but the observation was not very satisfactory.

At $1^h\ 14^m\ 34^s{\cdot}7$ Sid. $= 22^h\ 17^m\ 12^s{\cdot}4$ M.T. the Ingress was certainly past. During the seven seconds between this moment and that noted as the moment of internal contact there was some quivering and flickering of the luminous band between the limb of the planet and that of the Sun. The contact was noted at the instant when the black connection between the planet and Sun's limb *first* broke, which it did pretty suddenly.

At Egress the internal contact was noted at

$$8^h\ 42^m\ 06^s{\cdot}3 \text{ Sid. or } 5^h\ 43^m\ 30^s{\cdot}7 \text{ Princeton Mean Time.}$$

The external contact (through flying clouds) at

$$8^h\ 44^m\ 54^s{\cdot}3 \text{ Sid. or } 5^h\ 46^m\ 18^s{\cdot}3 \text{ Princeton Mean Time.}$$

Both observations were satisfactory, though the seeing was very bad. There was an interval of about 4^s at the internal contact, during which the band of light between the edge of the planet and the Sun was flickering, the time noted being that when several dark filaments first shot across. Two seconds earlier the band began to waver and change its appearance, and two seconds later it was quite certain that the contact was past. The external contact was equally definite.

The seeing was exceedingly bad, the limbs both of the Sun and planet being deeply serrated by the action of a strong cold N.W. wind, so that I was and still am surprised at the decisiveness and promptness with which the phases presented themselves.*

During the transit I examined the planet carefully with various powers from 100 to 500, and although the granulations of the Sun's disk often showed beautifully at moments of good seeing, I could make out nothing like a ring of light around the planet nor anything like a bright spot upon its disk. Once or twice, when the definition was specially good, I thought I could see that close around the planet there was a tendency to an apparent radiating structure of the solar "rice grains," as if the atmosphere of the planet had some elongating action upon their images. This is, however, just the opposite of the effect refraction would produce, and on the whole I fancy the apparent effect was wholly subjective.

The colour of the disk was a dark violet, exactly the same as that of a Sunspot seen with the same polarising eye-piece, or with a Herschel solar eye-piece and shade of "London smoke."

During the transit about 80 measures of the planet's diameter were made by bringing the disk between different sets of slightly

* Other observers here, with smaller telescopes of apertures between 3 and 4 inches, saw the "black drop" phenomenon most conspicuously. Dr. Alexander reports that the "black drop" at Ingress was so troublesome as to render his observation of contact entirely unsatisfactory.

converging lines, or rather bands, photographed on glass. The bands were made wide enough to destroy the effect of irradiation upon the planet's disk. There were six different sets of bands, and the observations were made by three different persons—Mr. W. Libbey, jun., Professor Rockwood, and myself. The magnifying powers were varied from 155 to 500, most of the observations being with the highest power.

A preliminary reduction, the results of which may be slightly, but only slightly, changed by a more complete discussion, gives the diameter of the planet, from set 1, $11''\cdot89$; set 2, $11''\cdot59$; set 3, $11''\cdot85$; set 4, $11''\cdot79$; set 5, $11''\cdot76$; and set 6, $11''\cdot56$. The general mean is $11''\cdot74$. The tabular diameter of the American Almanac is $11''\cdot99$.

Princeton, May 13, 1878.

Observations of the Transit of Mercury.

By S. P. Langley, Director of the Allegheny Observatory.

(*Communicated by E. Dunkin, Esq., F.R.S.*)

The Transit of *Mercury* of May 6 was observed here under the favourable circumstance of an exceptionally transparent blue sky in the early part of the day, which enabled some observations to be made which seem worth record.

The principal instruments were an achromatic of 13-inch aperture, with a polarising solar eye-piece, which gives images free from colour without the use of shade glasses; for photometry, a Jamin photometer, used with a camera attached to the telescope; for heat, the special apparatus used heretofore on the thermal measurements of Sunspot nuclei. In the field of the polarising eye-piece was a glass reticule, ruled in squares, whose sides were $15''$ each. Powers of from 120 to 800 were employed through the day at the eye-piece, and the image of the planet, greatly enlarged, was also projected on a white surface in the dark camera. The following are the chief results:—

(1) The entire disk of the planet was seen outside the Sun at about 30^s before first external contact, on a just perceptibly lighter background.

(2) The true diameter, which I suppose to have been seen under these circumstances, was estimated, by aid of the reticule, to be $\frac{1}{5}$ larger than that exhibited directly after, when the planet had entered on the Sun. (1st external contact, $21^h\ 52^m\ 50^s\cdot43$ Allegheny M.T., by chronograph.)

(3) There was momentarily good definition at first internal contact ($21^h\ 55^m\ 47^s\cdot25$ by chronograph, Allegheny M.T.), but no black drop or ligament was seen by me. (An assistant, using a 4-inch achromatic, with dark glass, saw a ligament, and observed contacts from 5 to 15 seconds later.)

(4) No bright spot or annulus was seen during the day.

(5) The planet was not seen black, as it has been often called. The light was not materially less than that of some Sunspot nuclei, but bluish grey, and measured 8 per cent. at the least of mean sunlight. (This will possibly be subject to a subsequent correction for imperfect achromatism.)

(6) There was unquestionable evidence of heat from the same direction.

(7) The planet was darker at the centre than at the edge, but in the photometric observations this was proved beyond question to be chiefly due to minute and rapid atmospheric tremor.

The following inferences seem obvious. From (1) we must conclude that the coronal background made its presence sensible without an eclipse to at least 15″ from the limb. From (2) that a correction of something like 20 per cent. is to be added to micrometric eye-measures of *Mercury* on the Sun, for irradiation. (4) The observation of these in previous transits rests on testimony not to be set aside. It may be asked, then, whether the condition of visibility is not an unusually good definition, like that enjoyed by Mr. Huggins in 1868. The definition, as regards steadiness, was here only ordinarily fair most of the day, though in the forenoon the transparency of the sky was, as has been remarked, unusual. (5) and (6) are to be interpreted, of course, not as evidence of light and heat actually radiated from *Mercury*, but as data for estimating with something like precision a lower limit for the effects of our own atmosphere in inflecting the *solar* radiation, and as giving useful quantitative results for the effects of "atmospheric glare." To make a single application: admitting that this atmospheric glare was like a bright veil, spreading eight per cent. of sunlight over both *Mercury* and the corona, and admitting also that the eye demanded at least one per cent. of excess of brightness in the background to make *Mercury* visible—we must evidently conclude that the actual brightness of the Inner Corona exceeds (at any rate) one one-thousandth of that of direct sunlight; or, as we may say in other words, the Inner Corona is several hundred times the average brilliancy of the full Moon.

Allegheny Observatory, Allegheny, Pa.,
May 13, 1878.

The Transit of Mercury, 1878, *May* 6, *observed at the Astro-physical Observatory, Ó-Gyalla, Hungary.* By Dr. Nicolas de Konkoly, Member of the R. Academy, Budapest.

(*Communicated by Mr. H. M. Christie.*)

There were five observers of the Transit: to prevent them from being under the influence of each other, they were dispersed in the Park near the Observatory.

I observed with my $6\frac{1}{4}$-inch Refractor, provided with clockwork and a polarising solar eye-piece, by Merz of Munich. My assistant, Dr. Schrader, observed the contacts with the $10\frac{1}{4}$-inch Reflector Equatoreal by Browning, with a Browning double reflecting solar eye-piece; Capt. Reviczky observed with a large comet-finder, azimuthally mounted, with an aperture of $4\frac{1}{2}$ inches; Mr. Alexander Cvet, from Russia, observed with a 3-inch achromatic, by Bardoux of Paris; Lieut. Horwáth with a $3\frac{1}{2}$-inch comet-finder; and Mr. T. Kaiser, Engineer, with an achromatic telescope of nearly 4 inches.

After the contact observations I measured right ascension differences with Dr. Schrader. I made my measures with the $6\frac{1}{4}$-inch Merz, with a Browning filar-micrometer; and Dr. Schrader measured with the Heliograph, which has an object-glass of 3 inches by Reinfelder and Hertel of Munich. This instrument is mounted and constructed only for observing the Sun, and is provided also with exquisite clockwork.

The contacts were observed as follows:—

First Contact.

Name of Observer.	Greenwich M.T. h	m	s	Ó-Gyalla M.T. h	m	s
Lieut. Horváth	3	12	10·4	4	24	56
Alexander Cvet	3	12	31·4 [?]	4	25	17 [?]
Joseph Kaiser	3	12	7·4	4	24	52

Second Contact (Inner).

Name of Observer.	Greenwich M.T. h	m	s	Ó-Gyalla M.T. h	m	s
Lieut. Horváth	3	14	31·4 [?]	4	27	17 [?]
Alexander Cvet	3	13	58·4 [?]	4	26	43 [?]
Joseph Kaiser	3	13	44·4	4	26	30
Dr. Schrader	3	13	45·4	4	26	31
Dr. Konkoly	3	13	45·4	4	26	31

Capt. Reviczky saw nothing of the phenomena. He had badly arranged the Barlow lens and eye-piece in the telescope supplied to him.

None of the observers saw the planet before it touched the Sun's limb, and no one observed either the "black drop" or an aureola round the planet, or any white spot upon its surface.

I measured six transits of east–west limb from Sun and *Mercury*, and my assistant, Dr. Schrader, measured ten. All transits were noted on the chronograph as follows:—

Observer: Konkoly.

No.	Ó-Gyalla M.T.			Greenwich M.T.			Δ ☿ − ☉		No. of Webs as observed.
	h	m	s	h	m	s	m	s	
I	4	45	0·1	3	32	14·5	+0	42·64	7
II	4	56	12·7	3	43	27·1	+0	39·67	5
III	5	1	12·9	3	48	27·3	+0	38·60	7
IV	5	26	42·9	4	13	57·3	+0	32·36	7
V	5	44	0·1	4	31	14·5	+0	27·97	6
VI	5	47	53·2	4	35	7·6	+0	27·33	7

Observer: Schrader.

No.	Ó-Gyalla M.T.			Greenwich M.T.			Δ ☿ − ☉		No. of Webs as observed.
	h	m	s	h	m	s	m	s	
I	4	34	37·9	3	21	52·3	+0	45·19	3
II	4	37	18·9	3	24	33·3	+0	44·49	5
III	4	40	7·9	3	27	22·3	+0	44·07	5
IV	4	49	11·8	3	36	26·2	+0	41·50	5
V	4	52	1·7	3	39	16·1	+0	40·94	5
VI	5	12	39·2	3	59	53·6	+0	35·55	5
VII	5	15	28·1	4	2	42·5	+0	35·09	4
VIII	5	30	54·7	4	18	9·1	+0	31·10	7
IX	5	33	55·3	4	21	9·7	+0	30·23	7
X	5	59	13·1	4	46	27·5	+0	24·07	6

The differences are yet free [*sic*] from atmospheric refraction. I have also given Greenwich mean time to facilitate the comparison of my observations with English observations. The Δ ☿ − ☉ is mean solar time.

The Heliograph is a new instrument, installed on the 1st of November of last year in the smaller drum of the Observatory. It is mounted equatoreally on a stone pillar, with driving clock-work apparatus. There is no continuous tube, but a framework of steel and brass rods for supporting the object-glass and the eye-glass: the Sun's image is more steady than in an instrument with a wooden or brass tube. The object-glass is one of the best quality, made by Reinfelder and Hertel of Munich.

The Ó-Gyalla Observatory is $1^h\ 12^m\ 45^s{\cdot}59$ E. of Greenwich; the latitude is $47°\ 52'\ 43''{\cdot}0$ N.

Ó-Gyalla Observatory,
1878, *June* 8.